TABLE 1.—Temperature Gradient at the Empire-Star Mine, Grass Valley, Nevada County, California[a]

Location of temp. observation		Depth[b]		Observed temperatures		0–980 Ft.		0–3400 Ft.		Constants[c]
Mine	Level	Meters	Feet	Cent.	Fahr.	Comp. temp.	Obs. minus comp.	Comp. temp.	Obs. minus comp.	
Empire	1100	0.0	0	12.4	54.4	54.2	+0.2	54.6	−0.2	0–980 ft.
Pennsylvania	1000	45.7	150	12.9	55.3	55.1	+0.2	55.4	−0.1	a = 54.17
New York Hill	600	94.5	310	13.1	55.6	56.0	−0.4	56.3	−0.7	b = 0.00593
North Star	1900	114.3	375	13.6	56.4	56.3	+0.1	56.6	−0.2	$1/b$ = 168.6
Pennsylvania	1400	128.0	420	13.5	56.3	56.7	−0.4	56.8	−0.5	r = ±0.18
Pennsylvania	1700	192.0	630	14.3	57.7	57.9	−0.2	57.9	−0.2	r_a = ±0.11
Empire	2700	207.3	680	14.7	58.5	58.2	+0.3	58.2	+0.3	r_b = ±0.00017
Pennsylvania	2100	256.0	840	15.1	59.1	59.1	0.0	59.1	0.0	0–2100 ft.
Empire	3000	257.5	845	15.3	59.5	59.2	+0.3	59.1	+0.4	a = 54.32
Pennsylvania	2400	292.6	960	15.5	59.9	59.9	0.0	59.7	+0.2	b = 0.00569
Empire	3400	298.7	980	15.5	59.9	60.0	−0.1	59.8	+0.1	$1/b$ = 175.8
Empire	3800	377.9	1240	16.6	61.8	61.5	+0.3	61.2	+0.6	r = ±0.21
Empire	4200	432.8	1420	17.2	62.9	62.6	+0.3	62.1	+0.8	r_a = ±0.10
Empire	4600	496.8	1630	17.4	63.3	63.8	−0.5	63.2	+0.1	r_b = ±0.00009
Empire	5000	559.3	1835	17.9	64.3	65.1	−0.8	64.3	0.0	0–3120 ft.
Empire	5400	640.1	2100	19.0	66.2	66.6	−0.4	65.7	+0.5	a = 54.55
Empire	5800	719.3	2360	19.5	67.1	68.2	−1.1	67.1	0.0	b = 0.00537
Empire	6200	795.5	2610	20.2	68.3	69.7	−1.4	68.4	−0.1	$1/b$ = 186.1
Empire	7000	951.0	3120	21.6	70.8	72.7	−1.9	71.1	−0.3	r = ±0.25
North Star	8700	1005.8	3300	22.0	71.6	73.7	−2.1	72.0	−0.4	r_a = ±0.10
North Star	9000	1036.3	3400	22.4	72.3	74.3	−2.0	72.5	−0.2	r_b = ±0.00007
										0–3400 ft.
										a = 54.63
										b = 0.00527
										$1/b$ = 189.8
										r = ±0.26
										r_a = ±0.09
										r_b = ±0.00005

[a] Observations made in 1930–31. Most of the observations were made in air or standing water outside of the path of air circulation.

[b] Depth below Empire 1100 level, altitude 2200 ft., which is taken as the temperature datum. This is about 300 ft. below the surface of the ground.

[c] Constants have been determined by the method of least squares from the equation $y = a + bx$.

in which

y = temperature at depth x.

a = computed annual mean temperature just beneath the surface of the earth.

b = gradient in degrees Fahrenheit per foot.

$1/b$ = reciprocal gradient in feet per degree Fahrenheit.

r = probable error of observation y, weight unity.

r_a, r_b = probable error of a and b.

All of the computations in this paper were carried out by Mr. H.

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The depth-temperature curve (see Fig. 1) is slightly concave toward the depth axis. This is clearly shown in the following values of the reciprocal gradients taken from Table 1.

From 300 to 1280 feet, 1°F. for every 168.6 feet.
From 300 to 2400 feet, 1°F. for every 175.8 feet.
From 300 to 3420 feet, 1°F. for every 186.1 feet.
From 300 to 3700 feet, 1°F. for every 189.8 feet.

As the rock temperature on the 9000 level of the North Star mine is only 72.3°F., underground temperature offers no hindrance to mining operations.

TABLE 2—TEMPERATURE OF DEEP MINES

	Observed $T.$ at 100 feet	Greatest depth	Observed $T.$ at greatest depth	100 to 1000 ft.				100 ft. to greatest depth			
	Fahr.	Feet	Fahr.	a	b	$1/b$	r	a	b	$1/b$	r
Grass Valley, Calif...	54.4[a]	3700	72.3	54.17	0.00593	168.6	0.18	54.63	0.00569	189.8	0.26
Mother Lode, Calif.[b]..	.....	4200	86.0	.....	.....	.....	.....	64.39	0.00520	192.3	1.73
Calumet, Mich.[c].....	44.6	5367	89.7	42.47	0.01009	99.1	0.65	43.44	0.00852	117.4	1.31
" " [d].....	.....	5679	95.3	.....	.....	.....	.....	.....	.....	108.5	....
Minas Geraes, Brazil[c].	.....	6140	115.7	.....	.....	.....	.....	.....	0.00801	124.8	....
Johannesburg, S. Africa[c].....	.....	7032	97.0	.....	.....	.....	.....	.....	0.00495	202.1	....

[a] 300± ft.

[b] Knopf, Adolph. *Mother Lode system of Calif.* U. S. Geol. Survey, Prof. Paper 157: 22–23. 1929. Gradient recalculated from Knopf's data by H. Cecil Spicer.

[c] Van Orstrand, C. E. *On the nature of isogeothermal surfaces.* Am. Jour. Science, 15: 509–11. 1928.

[d] Ingersoll, L. A. *Geothermal gradient determinations in the Lake Superior copper mines* (abstr.). Physical Review, 39: No. 5, 869–70. 1932.

In Figure 1 the observed surface mean annual temperature at Grass Valley and Nevada City are shown. The mean annual temperature for Nevada City,[3] six miles north of the mine, obtained over a period of 39 years, is 52.6°, agreeing with the calculated subsurface temperature within 1°. The mean annual temperature near the mine at Grass Valley,[3] however, taken over a period of only 22 years is 60.3° or 7° higher than the calculated subsurface temperature.

The thermal gradient at Grass Valley, as shown in Table 2, is in

[3] U. S. Weather Bureau. Climatological Data, **17**: No. 13, 88–99. 1930.

close agreement with the thermal gradient on the Mother Lode.[4] It slightly exceeds the gradient in the Rand, S. Africa, and is much less than the gradient in the Michigan copper mines and in the St. John del Rey mine, Brazil.

[4] Knopf, Adolph. *Mother lode system of California.* U. S. Geol. Survey Prof. Paper **157**: 22–23. 1929. Knopf gives a gradient of 1°F. for 150 feet. His data have been recalculated by the method of least squares by H. C. Spicer, who obtained a reciprocal gradient of 192.3 feet per degree Fahrenheit from observations between the depths of 1575 and 4200 feet. Knopf's values for the Central Eureka and the Kennedy mines apparently are based on an assumed value of the mean annual temperature y of the air.

ZOOLOGY.—*A new trematode,* Acanthatrium eptesici, *from the brown bat.*[1]

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Three flukes representing a new species of trematode belonging to the family Lecithodendridae Odhner, 1910, and to the genus *Acanthatrium* Faust, 1919, were collected by the writer in November, 1931, from the intestine of the brown bat, *Eptesicus fuscus*, captured in Washington, D. C. The new species is described in this paper.

Acanthatrium eptesici, new species

Figs. 1 and 2.

Specific diagnosis.—Acanthatrium: Body rounded, flattened dorsoventrally, from 702μ to 1.2 mm. long by 468 to 764μ wide in middle of body. Cuticular spines absent. Oral sucker subterminal, 98 to 114μ long by 98 to 114μ wide; acetabulum 72 to 98μ long by 80 to 98μ wide. Prepharynx absent; pharynx 38 to 45μ long by 49 to 53μ wide; esophagus 34 to 76μ long. Intestinal ceca short, simple, extending to anterior margins of testes. Excretory bladder V-shaped. Testes ovoid to pyriform, located on same zone as acetabulum, and transverse in position; right testis 121 to 281μ long by 129 to 205μ wide; left testis 121 to 258μ long by 91 to 197μ wide. Seminal vesicle long and coiled; prostate cells numerous, forming a mass 121 to 327μ long by 186 to 358μ wide. The entire mass is enclosed in a delicate sac-like membrane. Genital pore somewhat anterior to acetabulum and anterior to zone of testes. Genital atrium slightly anterior to genital pore, and lined with one group of long, narrow spines. Ovary ovoid, regular or lobed, the largest axis transverse, oblique or longitudinal in position. Vitellaria composed of large follicles which may extend from about level of pharynx to anterior margins of testes. Uterus long and arranged for the most part transversely, occupying posterior half of body length and terminating in a moderately developed metraterm. Eggs oval, 20 to 30μ long by 15μ wide, with yellowish brown, thin shell.

Host.—Eptesicus fuscus.

Location.—Small intestine.

Distribution.—United States (Washington, D. C.).

Type specimen.—U. S. N. M. Helm. Coll. No. 30135; paratypes No. 30136.

Acanthatrium eptesici differs from the other two species of the genus, namely *A. sphaerula* (Looss, 1896) Faust, 1919, and *A. nycteridis* Faust, 1919,

[1] Received March 16, 1932.

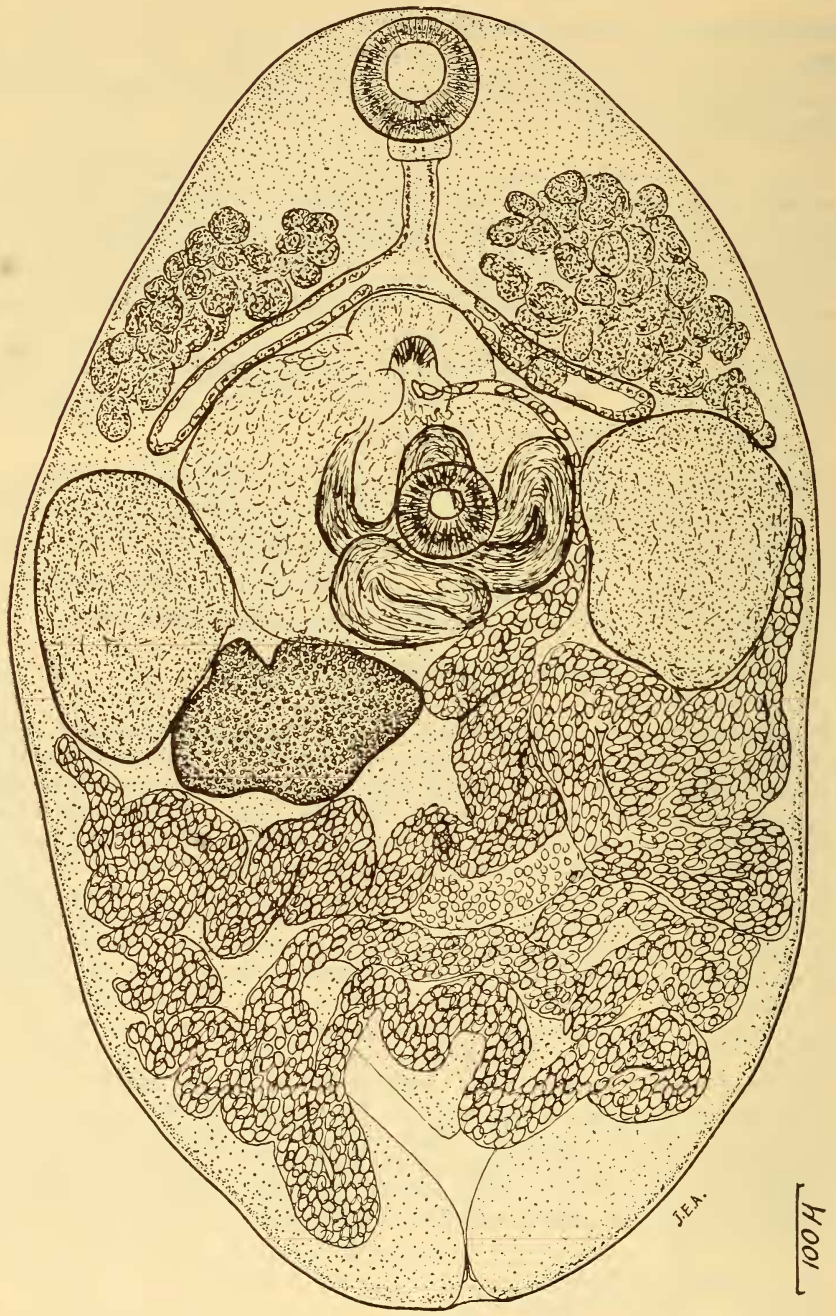

Fig. 1.—*Acanthatrium eptesici*, Alicata. Ventral view.

as follows: The genital atrium in *A. sphaerula* has spines distributed over its entire wall and the genital pore opens at the right side of the prostate gland mass, whereas in *A. eptesici* the spines are limited to a semicircular area of